

We claim:

1. A process for forming an extended polyalkylene-grafted interpolpolymer or gel, comprising:

a) mixing

1) a polymer comprising mer units derived from maleic anhydride and mer units derived from at least one of

(A) a vinyl aromatic monomer, and

(B) an R¹(R²)ethylene monomer in which R¹ and R²

independently are selected from H and substituted or unsubstituted C₁-C₂₀ alkyl or alkoxy groups, and

2) a maleated polyalkylene, so as to form a blend;

b) to said blend, adding a diamine and allowing it to react with the mer units derived from maleic anhydride and with the maleated polyalkylene to form a polyalkylene grafted interpolpolymer; and

c) allowing the polyalkylene-grafted interpolpolymer to cool in said mixer and adding an extender to provide said extended polyalkylene-grafted interpolpolymer; and

d) optionally, extruding the extended polyalkylene-grafted interpolpolymer to form a gel having a tan δ of at least 0.3.

2. The process of claim 1 wherein step a) includes from about 50 to about 99 weight % of said polymer and from about 1 to about 50 weight % of said maleated polyalkylene and wherein step b) includes from about 0.1 to about 10 weight % of said diamine.

3. The process of any of claims 1 to 2 wherein said polymer comprises from about 0.01 to about 5 weight percent mer units derived from maleic anhydride.

4. The process of any of claims 1 to 3 wherein steps b), c) and, optionally a) are carried out sequentially in a mixer, with no physical manipulation of said polyalkylene grafted interpolpolymer prior to step c) and without removing any of the materials from said mixer.

5. The process of any of claims 1 to 4 wherein step c) includes mixing about 10 weight percent to about 90 weight percent of said polyalkylene-grafted interpolymer with a total amount of about 90 weight percent to about 10 weight percent of said extender.

6. The process of any of claims 1 to 5 wherein at least one of the following is true:

said vinyl aromatic monomer is selected from any one or more of styrene, α -methylstyrene, *p*-methylstyrene, 4-phenylstyrene, *m*-methylstyrene, *o*-methylstyrene, *p*-tert-butylstyrene, and dimethylstyrene.

R^1 and R^2 independently are selected from methyl, ethyl, propyl, isopropyl, butyl, isobutyl, pentyl, isopentyl, hexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl, tridecyl, tetradecyl, pentadecyl, hexadecyl, heptadecyl, octadecyl, nonadecyl, eicosyl, cyclopropyl, 2,2-dimethylcyclopropyl, cyclopentyl, cyclohexyl, methoxymethyl, methoxyethyl, methoxypropyl, methoxybutyl, methoxypentyl, methoxyhexyl, methoxyoctyl, methoxynonyl, ethoxydecyl, ethoxymethyl, ethoxyethyl, ethoxypropyl, ethoxybutyl, ethoxypentyl, ethoxyhexyl, ethoxyheptyl, ethoxyoctyl, ethoxynonyl, ethoxydecyl, propoxymethyl, propoxyethyl, propoxypropyl, propoxybutyl, propoxypentyl, propoxyheptyl, propoxyoctyl, propoxynonyl, propoxydecyl, butoxymethyl, butoxyethyl, butoxypropyl, butoxybutyl, butoxypentyl, butoxyhexyl, butoxyheptyl, butoxyoctyl, butoxynonyl, butoxydecyl, pentyloxymethyl, pentyloxyethyl, pentyloxypropyl, pentyloxybutyl, pentyloxypentyl, pentyloxyhexyl, pentyloxyoctyl, pentyloxynonyl, pentyloxydecyl, hexyloxymethyl, hexyloxyethyl, hexyloxypropyl, hexyloxybutyl, hexyloxypentyl, hexyloxyhexyl, hexyloxyheptyl, hexyloxyoctyl, hexyloxynonyl, hexyloxydecyl, heptyloxymethyl, heptyloxyethyl, heptyloxypropyl, heptyloxybutyl, heptyloxypentyl, heptyloxyhexyl, heptyloxyheptyl, heptyloxyoctyl, heptyloxynonyl, heptyloxydecyl, octyloxymethyl, octyloxyethyl, octyloxypropyl, octyloxybutyl, octyloxypentyl, octyloxyhexyl, octyloxyheptyl, octyloxyoctyl, octyloxynonyl, decyloxymethyl, decyloxyethyl, decyloxypropyl, decyloxybutyl, decyloxypentyl, decyloxyhexyl, decyloxyheptyl, 1-methylethyl, 1-methylpropyl, 1-methylbutyl, 1-methylpentyl, 1-methylhexyl, 1-methylheptyl, 1-methyloctyl, 1-methylnonyl, 1-methyldecyl, 2-methylpropyl, 2-methylbutyl, 2-methylpentyl, 2-methylhexyl, 2-methylheptyl, 2-methyloctyl, 2,3,3-trimethylbutyl, 3-methylpentyl, 2,3-dimethylpentyl, 2,4-dimethylpentyl, 2,3,3,4-tetramethylpentyl, 3-methylhexyl, and 2,5-dimethylhexyl.

7. The process of any of claims 1 to 6 wherein said maleated polyalkylene includes mer units derived from at least one of ethylene and propylene.

5 8. The process of any of claims 1 to 7 wherein, prior to step a), an amine is reacted with a portion of the mer units derived from the maleic anhydride to form maleimide mer units, wherein at least one of the following optionally is true of said imidization:

10 it is carried out immediately preceding step a) with no physical manipulation of the polymer prior to step a), and

it and step a) are carried out in a mixer without removing the imidization product from the mixer.

15 9. The process of claim 8, wherein said amine comprises from 1 to 50 carbon atoms and is selected from at least one of alkyl amines, alkyl benzyl amines, alkyl phenyl amines, alkoxybenzyl amines, alkyl aminobenzoates, and alkoxy aniline.

10. The process of claim 8, wherein said amine is a primary amine.

5-10 11. The process of any of claims 1 to 8 wherein said diamine is selected from aliphatic or cycloaliphatic diamines corresponding to the general formula $R^3(NH_2)_2$ wherein R^3 represents

- 1) a $C_2 - C_{20}$ aliphatic hydrocarbon group,
- 2) a $C_4 - C_{20}$ cycloaliphatic hydrocarbon group,
- 3) a $C_6 - C_{20}$ aromatic hydrocarbon group, or
- 4) a $C_4 - C_{20}$ N-heterocyclic ring.

25 12. The process of claim 11, wherein said diamine is selected from at least one of ethylene diamine; 1,2-propylene diamine; 1,3-propylene diamine; 1,4-diaminobutane; 2,2-dimethyl-1,3-diaminopropane; 1,6-diaminohexane; 2,5-dimethyl-2,5-diaminohexane; 1,6-diamino-2,2,4-trimethyldiaminohexane; 1,8-diaminooctane; 1,10-diaminodecane; 1,11-diaminoundecane; 1,12-diaminododecane; 1-methyl-4-(aminoisopropyl)-cyclohexylamine; 3-aminomethyl-3,5,5-trimethyl-cyclohexylamine; 1,2-bis-(aminomethyl)-cyclobutane; 1,2-diamino-3,6-dimethylbenzene; 1,2-diaminocyclohexane; 1,4-diaminocyclohexane; 1,2-diaminodecalin; 1,4-diaminodecalin; 1,5-diaminodecalin; 1,8-diaminodecalin; 1-

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methy1-4-aminoisopropyl-cyclohexylamine; 4,4'-diamino-dicyclohexyl; 4,4'-diamino-dicyclohexyl methane; 2,2'-(bis-4-amino-cyclohexyl)-propane; 3,3'-dimethyl-4,4'-diamino-dicyclohexyl methane; 1,2-bis-(4-aminocyclohexyl)-ethane; 3,3',5,5'-tetramethyl-bis-(4-aminocyclohexyl)-methane; 3,3',5,5'-tetramethyl-bis-(4-aminocyclohexyl)-propane; 1,4-bis-(2-aminoethyl)-benzene; benzidine; 4,4'-thiodianiline, 3,3'-dimethoxybenzidine; 2,4-diaminotoluene, diaminoditolylsulfone; 2,6-diaminopyridine; 4-methoxy-6-methyl-*m*-phenylenediamine; diaminodiphenyl ether; 4,4'-bis(*o*-toluidine); *o*-phenylenediamine; methylene-bis(*o*-chloroaniline); bis(3,4-diaminophenyl)sulfone; diaminodiphenylsulfone; 4-chloro-*o*-phenylenediamine; *m*-aminobenzylamine; *m*-phenylenediamine; 4,4'-C₁-C₆-dianiline; aniline-formaldehyde resin; trimethylene glycol di-*p*-aminobenzoate; bis-(2-aminoethyl)-amine; bis-(3-aminopropyl)-amine; bis-(4-aminobutyl)amine; bis-(6-aminohexyl)-amine; and isomeric mixtures of dipropylene triamine and dibutylene triamine.

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13. ✓ A single batch process for preparing a polymer composition which includes a polyalkylene-grafted interpolmer, said process comprising:

- a) forming a maleimide interpolmer in a mixing vessel by reacting an amine with a portion of maleic anhydride-derived mer units of an interpolmer comprising maleic anhydride-derived mer units and at least one of
 - 1) vinyl aromatic-derived mer units, and
 - 2) R¹(R²)ethylene-derived mer units in which R¹ and R² independently are H or substituted or unsubstituted C₁ to C₂₀ alkyl groups or alkoxyl groups;
- b) adding sufficient maleated polyalkylene such that the mixing vessel contains from about 1 to about 50 weight percent maleated polyalkylene and from about 50 to about 99 weight percent maleimide interpolmer;
- c) mixing from about 0.1 to about 10 weight % of a diamine with the maleimide interpolmer and maleated polyalkylene in the mixing vessel to form said polyalkylene-grafted interpolmer; and
- d) optionally, without removing the product of step c) from the vessel, cooling the polyalkylene-grafted interpolmer in the mixer to a temperature at which an extender is stable in the polyalkylene-grafted interpolmer, and adding an extender to the mixer.

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